What is claimed is:

1. A method for forming a rough conductive layer in the fabrication of integrated circuits, the method comprising:

providing a substrate assembly in a reaction chamber, the substrate assembly including a surface;

maintaining the substrate assembly surface at a temperature in a range of about 100°C to about 400°C;

maintaining the pressure of the reaction chamber in a range of about 0.4 torr to about 10 torr; and

providing a carrier gas at a flow rate of about 100 sccm to about 500 sccm through a ruthenium-containing precursor maintained at a temperature of about 15 °C to about 100 °C into the reaction chamber to deposit a rough ruthenium layer on the surface of the substrate assembly.

2. The method of claim 1, wherein the method further includes providing a diluent gas at a flow rate of about 100 sccm to about 500 sccm.

3. The method of claim 1, wherein maintaining the substrate assembly surface at a temperature includes maintaining the substrate assembly surface at a temperature in the range of about 150°C to about 250°C.

4. The method of claim 1, wherein the rough ruthenium layer is deposited at a rate of about 100 Å/minute to about 500 Å/minute.

5. The method of claim 4, wherein the rough ruthenium layer is deposited at a rate of about 200 Å/minute to about 300 Å/minute.

6. The method of claim 4, wherein the RMS roughness of the rough ruthenium layer is in a range of about 50 Å to about 600 Å.

7. The method of claim 4, wherein a nominal center cross-section area of grains at a surface of the rough ruthenium layer is in a range of about 100 Å to about 800 Å.

8. The method of claim 1, wherein the method further includes annealing the rough ruthenium layer at a temperature in a range of about 300°C to about 900°C for a time period in a range of about 30 seconds to about 30 minutes.

9. The method of claim 8, wherein annealing the rough ruthenium layer further includes annealing the rough ruthenium layer at a pressure in a range of about 0.1 millitorr to about 5 atmospheres in a gas atmosphere subjected to a glow discharge created by applying an electromagnetic field across the gas mixture.

10. The method of claim 9, wherein the gas atmosphere is selected from one of oxygen, ozone, nitrogen, argon or a combination thereof, and further wherein the glow discharge is created by applying a radio frequency electromagnetic field of 13.56 megahertz at a power density of 0 to about 5 kW/cm^2 across the gas atmosphere.

11. A method for forming a rough conductive layer in the fabrication of integrated circuits, the method comprising:

providing a substrate assembly in a reaction chamber, the substrate assembly including a surface;

providing a ruthenium-containing precursor into the reaction chamber;

depositing a rough ruthenium layer on the surface of the substrate assembly at a rate of about 100 Å/minute to about 500 Å/minute.

12. The method of claim 11, wherein the rough ruthenium layer is deposited at a rate of about 200 Å/minute to about 300 Å/minute.

13. The method of claim 11, wherein providing a ruthenium-containing precursor into the reaction chamber includes providing a carrier gas at a flow rate of about 100

sccm to about 500 sccm through the ruthenium-containing precursor maintained at a temperature of about 15 °C to about 100 °C and into the reaction chamber to deposit the rough ruthenium layer on the surface of the substrate assembly.

14. The method of claim 11, wherein the method further includes maintaining the substrate assembly surface at a temperature in a range of about 100°C to about 400°C.

15. The method of claim 11, wherein the method further includes maintaining the pressure of the reaction chamber in a range of about 0.4 torr to about 10 torr.

16. The method of claim 11, wherein the method further includes annealing the rough ruthenium layer at a temperature in a range of about 300°C to about 900°C for a time period in a range of about 30 seconds to about 30 minutes.

17. The method of claim 16 wherein annealing the rough ruthenium layer further includes annealing the rough ruthenium layer at a pressure in a range of about 0.1 millitorr to about 5 atmospheres in a gas atmosphere subjected to a glow discharge created by applying an electromagnetic field across the gas mixture.

18. The method of claim 11, wherein providing the substrate assembly surface includes providing non-rough ruthenium, the rough layer of ruthenium formed on the non-rough ruthenium.

19. The method of claim 11, wherein providing the substrate assembly surface includes providing non-rough ruthenium oxide, the rough layer of ruthenium formed on the non-rough ruthenium oxide.

20. A method for forming a rough conductive layer in the fabrication of integrated circuits, the method comprising:

providing a substrate assembly in a reaction chamber, the substrate assembly including a surface;

providing a ruthenium-containing precursor into the reaction chamber;

providing an oxygen-containing precursor into the reaction chamber;

depositing a rough ruthenium oxide layer on the surface of the substrate assembly at a rate of about 100 Å/minute to about 1200 Å/minute.

21. The method of claim 20, wherein the rough ruthenium oxide layer is deposited at a rate of about 300 Å/minute to about 600 Å/minute.

22. The method of claim 20, wherein providing a ruthenium-containing precursor into the reaction chamber includes providing a carrier gas at a flow rate of about 100 sccm to about 500 sccm through the ruthenium-containing precursor maintained at a temperature of about 15 °C to about 100 °C and into the reaction chamber, and further wherein providing the oxygen-containing precursor into the reaction chamber includes providing an oxygen-containing precursor into the reaction chamber at a flow rate of about 100 sccm to about 2000 sccm.

23. The method of claim 22, wherein the method further includes maintaining the substrate assembly surface at a temperature in a range of about 100°C to about 400°C.

24. The method of claim 21, wherein the method further includes maintaining the pressure of the reaction chamber in a range of about 0.4 torr to about 100 torr.

25. The method of claim 20, wherein the RMS roughness of the rough ruthenium oxide layer is in a range of about 50 Å to about 600 Å.

26. The method of claim 20, wherein a nominal center cross-section area of grains at a surface of the rough ruthenium oxide layer is in a range of about 100 Å to about 800Å.

27. The method of claim 20, wherein the method further includes annealing the rough ruthenium oxide layer at a temperature in a range of about 300°C to about 900°C for a time period in a range of about 30 seconds to about 30 minutes.

28. The method of claim 27, wherein annealing the rough ruthenium oxide layer further includes annealing the rough ruthenium oxide layer at a pressure in a range of about 0.1 millitorr to about 5 atmospheres in a gas atmosphere subjected to a glow discharge created by applying an electromagnetic field across the gas mixture.

29. The method of claim 20, wherein providing the substrate assembly surface includes providing non-rough ruthenium, the rough layer of ruthenium oxide is formed on the non-rough ruthenium.

30. A conductive structure comprising at least a rough ruthenium layer, wherein a surface of the rough ruthenium layer has a surface area greater than about 1.2 times a surface area of a completely smooth surface having a substantially identical shape as the surface of the rough ruthenium layer.

31. The conductive structure of claim 30, wherein the surface of the rough ruthenium layer has a surface area greater than about 1.5 times the surface area of the completely smooth surface having the substantially identical shape as the surface of the rough ruthenium layer.

32. The conductive structure of claim 30, wherein an RMS roughness of the surface of the rough ruthenium layer is in a range of about 50 Å to about 600 Å.

33. The conductive structure of claim 30, wherein a nominal center cross-section area of grains at the surface of the rough ruthenium layer is in a range of about 100 Å to about 800 Å.

34. The conductive structure of claim 30, further comprising non-rough ruthenium having a surface region upon which the layer of rough ruthenium is formed.

35. The conductive structure of claim 30, further comprising non-rough ruthenium oxide having a surface region upon which the layer of rough ruthenium is formed.

36. A conductive structure comprising at least a rough ruthenium oxide layer, wherein a surface of the rough ruthenium oxide layer has a surface area greater than about 1.2 times a surface area of a completely smooth surface having a substantially identical shape as the surface of the rough ruthenium oxide layer.

37. The conductive structure of claim 36, wherein the surface of the rough ruthenium oxide layer has a surface area greater than about 1.2 times the surface area of the completely smooth surface having the substantially identical shape as the surface of the rough ruthenium oxide layer.

38. The conductive structure of claim 36, wherein the RMS roughness of the surface of the rough ruthenium oxide layer is in a range of about 50 Å to about 600 Å.

39. The conductive structure of claim 36, wherein a nominal cross-section grain size of grains at the surface of the rough ruthenium oxide layer is in a range of about 100 Å to about 800 Å.

40. The conductive structure of claim 36, further comprising non-rough ruthenium-containing material having a surface region upon which the layer of rough ruthenium oxide is formed.

41. A method of forming a conductive structure comprising:

forming non-rough ruthenium-containing material at a first deposition rate; and

forming rough ruthenium-containing material on the non-rough ruthenium-containing material at a second deposition rate, wherein the second deposition rate is greater than the first deposition rate.

42. The method of claim 41, wherein the rough ruthenium-containing material is formed of ruthenium and the non-rough ruthenium-containing material is formed of ruthenium.

43. The conductive structure of claim 41, wherein the rough ruthenium-containing material is formed of ruthenium oxide and the non-rough ruthenium-containing material is formed of ruthenium.

44. The conductive structure of claim 41, wherein the rough ruthenium-containing material is formed of ruthenium and the non-rough ruthenium-containing material is formed of ruthenium oxide.

45. The conductive structure of claim 41, wherein the rough ruthenium-containing material is formed of ruthenium oxide and the non-rough ruthenium-containing material is formed of ruthenium oxide.

46. A method for use in forming a capacitor, the method comprising:

providing a substrate assembly in a reaction chamber, the substrate assembly including at least one surface; and

forming an electrode on the at least one surface of the substrate assembly, wherein forming the electrode comprises:

providing a ruthenium-containing precursor into the reaction chamber, and

depositing a rough ruthenium layer on the surface of the substrate assembly from the ruthenium precursor at a rate of about 100 Å/minute to about 500 Å/minute.

47. The method of claim 46, wherein the substrate assembly includes an opening defined therein, wherein the opening is defined by a bottom surface of the substrate assembly and at least one side wall extending therefrom.

48. The method of claim 46, wherein providing a ruthenium-containing precursor into the reaction chamber includes providing a carrier gas at a flow rate of about 100 sccm to about 500 sccm through a ruthenium-containing precursor maintained at a temperature of about 15 °C to about 100 °C into the reaction chamber to deposit the rough ruthenium layer on the surface of the substrate assembly.

49. The method of claim 48, wherein the method further includes maintaining the substrate assembly surface at a temperature in a range of about 100°C to about 400°C and maintaining the pressure of the reaction chamber in a range of about 0.4 torr to about 10 torr.

50. The method of claim 48, wherein the method further includes annealing the rough ruthenium layer at a temperature in a range of about 300°C to about 900°C for a time period in a range of about 30 seconds to about 30 minutes.

51. The method of claim 50, wherein annealing the rough ruthenium layer further includes annealing the rough ruthenium layer at a pressure in a range of about 0.1 millitorr to about 5 atmospheres in a gas atmosphere subjected to a glow discharge created by applying an electromagnetic field across the gas mixture.

52. The method of claim 46, wherein providing the substrate assembly surface includes providing non-rough ruthenium, the rough layer of ruthenium formed on the non-rough ruthenium.

53. The method of claim 46, wherein providing the substrate assembly surface includes providing non-rough ruthenium oxide, the rough layer of ruthenium formed on the non-rough ruthenium oxide.

54. A method for use in forming a capacitor, the method comprising:

providing a substrate assembly in a reaction chamber, the substrate assembly including at least one surface; and

forming an electrode on the at least one surface of the substrate assembly, the forming of the electrode comprising:

providing a ruthenium-containing precursor into the reaction chamber,

providing an oxygen-containing precursor into the reaction chamber, and

depositing a rough ruthenium oxide layer on the surface of the substrate assembly at a rate of about 100 Å/minute to about 1200 Å/minute.

55. The method of claim 54, wherein the substrate assembly includes an opening defined therein, wherein the opening is defined by a bottom surface of the substrate assembly and at least one side wall extending therefrom.

56. The method of claim 54, wherein providing a ruthenium-containing precursor into the reaction chamber includes providing a carrier gas at a flow rate of about 100 sccm to about 500 sccm through the ruthenium-containing precursor maintained at a temperature of about 15 °C to about 100 °C into the reaction chamber, and further wherein providing the oxygen-containing precursor into the reaction chamber includes providing an oxygen-containing precursor into the reaction chamber at a flow rate of about 100 sccm to about 2000 sccm.

57. The method of claim 56, wherein the method further includes maintaining the substrate assembly surface at a temperature in a range of about 100°C to about 400°C and maintaining the pressure of the reaction chamber in a range of about 0.4 torr to about 100 torr.

58. The method of claim 56, wherein the method further includes annealing the rough ruthenium oxide layer at a temperature in a range of about 300°C to about 900°C for a time period in a range of about 30 seconds to about 30 minutes.

59. The method of claim 58, wherein annealing the rough ruthenium oxide layer further includes annealing the rough ruthenium layer at a pressure in a range of about 0.1 millitorr to about 5 atmospheres in a gas atmosphere subjected to a glow discharge created by applying an electromagnetic field across the gas mixture.

60. The method of claim 54, wherein providing the substrate assembly surface includes providing non-rough ruthenium, the rough layer of ruthenium formed on the non-rough ruthenium.

61. A capacitor structure comprising:

a first electrode formed of at least a rough ruthenium layer, wherein a surface of the rough ruthenium layer has a surface area greater than about 1.2 times a surface area of a completely smooth surface having a substantially identical shape as the surface of the rough ruthenium layer;

a dielectric layer formed on at least a portion of the first electrode; and

a second conductive layer formed on the dielectric layer.

62. The capacitor structure of claim 61, wherein the surface of the rough ruthenium layer has a surface area greater than about 1.5 times the surface area of the completely smooth surface having the substantially identical shape as the surface of the rough ruthenium layer

63. The capacitor structure of claim 61, wherein the first electrode further comprises non-rough ruthenium upon which the layer of rough ruthenium is formed.

64. The capacitor structure of claim 61, wherein the first electrode further comprises non-rough ruthenium oxide upon which the layer of rough ruthenium is formed.

65. A capacitor structure comprising:

a first electrode formed of at least a rough ruthenium oxide layer, wherein a surface of the rough ruthenium oxide layer has a surface area greater than about 1.2 times a surface area of a completely smooth surface having a substantially identical shape as the surface of the rough ruthenium oxide layer;

a dielectric layer formed on at least a portion of the first electrode; and

a second conductive layer formed on the dielectric layer.

66. The capacitor structure of claim 65, wherein the surface of the rough ruthenium layer has a surface area greater than about 1.5 times the surface area of the completely smooth surface having the substantially identical shape as the surface of the rough ruthenium layer.

67. The capacitor structure of claim 65, wherein the first electrode further comprises non-rough ruthenium upon which the layer of rough ruthenium oxide is formed.

68. The capacitor structure of claim 65, wherein the first electrode further comprises non-rough ruthenium oxide upon which the layer of rough ruthenium oxide is formed.